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## THE ADJUSTMENT OF CROP STATISTICS. II.

In an earlier paper it has been shown that after the publication of the twelfth census, in the late winter of 1901-2, a serious discrepancy between the figures of the Department of Agriculture and those of the Census Bureau had been noted. This discrepancy was found in the returns for every principal agricultural crop in the United States. It, moreover, has been pointed out that the student is apparently compelled to believe in the superior accuracy of the census figures as compared with those of the Department of Agriculture, unless satisfactory evidence going to discredit the work of the census office, and to throw unexpected shadows upon its methods, can be produced. We have seen, too, that during the months immediately succeeding the publication of the reports of the twelfth census, friends of the Agricultural Department sought to cast reflections upon the work of the census.

That the Agricultural Department should feel annoyed at the errors in its statistics which seemed to be revealed with the publication of the census figures, was natural. That its advocates should endeavor to sustain its returns, as compared with those of the census, was equally to be expected. Yet, how could this be done? To accept the returns of the rival bureau would have been a confession of defeat and an acknowledgment of error, indicating that the statistics were computed after radically wrong methods. Moreover, the friends of the department found support for the claim that the returns of the Census Bureau were too high, in the work of certain commercial estimators, whose figures fell below those of the census.

Rumors early began to be circulated that there had been much doubtful work in the census office. In many articles in newspapers, and particularly in commercial journals, the assertion was made that a great mass of statistical and other agricultural information was in possession of certain observers and that important facts concerning the census were known to them.

This information, it was said, tended to throw doubt upon the census methods and to prove beyond reasonable question that in very many respects the work of the bureau had been vitiated :

1. By an effort to get too elaborate and complex returns.
2. By a constant tendency in the office to exaggerate its figures through rules laid down for the conduct of clerks employed in tabulation.
3. Through mechanical errors made by the machinery employed in the bureau in the process of counting and tabulating the cards on which the data were represented.<sup>1</sup>

These statements varied greatly from time to time, and it seemed to be uncertain on which of the three general grounds just referred to the main basis of complaint should rest. It was, however, stated in explicit terms by some that, could an investigation be had, evidence concerning the work done in the Census Bureau could there be submitted, which would definitely convict that office of grave errors of method.

The work of the census office was thus attacked upon most important and serious grounds. It was vital to faith in the reputation of the office that these charges should be particularized and subjected to a test in order to ascertain precisely what basis for each of them could be found in the actual facts of the case. It was, therefore, to its interest that a non-partisan investigation should be held and the details of the work inspected. Before proceeding to trace the history of the investigation which actually took place, and the extent to which the report rendered by the investigators can be relied upon, it is necessary, in the interest of comprehensibility, to survey minutely the work done by the census office, recapitulating in detail the points at which errors might occur.

## I.

We have classified the charges against the census process under three general heads. Under the first of these heads a number of specific complaints were offered, to which reference will here be made.

<sup>1</sup> See this JOURNAL for December, 1902, pp. 10-12.

# SCHEDULE NO. 2 — AGRICULTURE.

1. NAMES OF PERSONS CONDUCTING FARM.	2. POST-OFFICE.	3. COLOR OF RACE.

5. If the farm is conducted by a tenant, or by a salaried superintendent or overseer, report in the blank spaces which follow the post office address of the person, firm, corporation, or institution owning the farm.

Name of owner \_\_\_\_\_

Post-office address \_\_\_\_\_

- |   |  |
|---|--|
| <p>6. Total number of acres, June 1, 1900, in farm (including all outlying or separate meadows, pastures, wood-lots, marshes, etc.) .....</p> <p>7. Number of acres, June 1, 1900, of unimproved land (<i>i. e.</i>, land which has never been plowed, mown or cropped, including land once cultivated but now grown up to trees and shrubs).....</p> <p>8. Number of acres, June 1, 1900, of improved land (including all not reported as unimproved).....</p> <p>9. Number of acres in this farm, June 1, 1900, owned by the occupant.....</p> <p>10. Number of acres rented or leased, June 1, 1900..</p> <p>NOTE.—The number of acres reported for question 6 should equal the total of those reported for 7 and 8, and also the total of those reported for 9 and 10.</p> <p>11. Value, June 1, 1900, of entire farm (including all owned or leased land contained therein, together with the value of the buildings and other permanent improvements).....\$</p> <p>12. Value, June 1, 1900, of all the buildings on the farm .....</p> | <p>13. Value, June 1, 1900, of all implements and machinery belonging to the farm (including all ordinary implements, all wagons, carriages, sleighs, harness, etc., and all apparatus for making butter and cheese, for ginning cotton, for making cider, wine, sugar, molasses, and sorghum, for drying fruit, and for threshing grain, or for similar purposes, together with the engines and other motor power for propelling the same).....</p> <p>14. Estimated value of all farm products (sold, consumed, or on hand) for 1899.....</p> <p>15. Amount expended in 1899 for fertilizers.....</p> <p>16. Amount expended in 1899 for farm labor (exclusive of housework), including the value of board furnished.....</p> <p>17. Number of acres irrigated in 1899, by ditches from natural streams.....</p> <p>18. Number of acres irrigated in 1899, by pumped or artesian well water.....</p> |
|---|--|

## GENERAL FARM PRODUCTS OF 1899.

FARM PRODUCTS.		ACRES HARVESTED.	QUANTITIES PRODUCED.		VALUES OF PRODUCTS.	FARM PRODUCTS.		ACRES HARVESTED.	QUANTITIES PRODUCED.	
19. GRAINS AND SEEDS.	Corn.....	}	Bu.	Shelled Corn	\$	21. MISCELLANEOUS CROPS.	Cotton.....	}	Lbs.	
			Bu.	Corn in the Ear					Bales	
			Bu.						Lbs.	
			Bu.						Lbs.	
			Bu.						Lbs.	
	Wheat .....		Bu.				Rice.....		Lbs.	
	Oats.....		Bu.				Tobacco.....		Lbs.	
	Barley .....		Bu.				Hemp.....		Lbs.	
	Rye .....		Bu.				Hops .....		Lbs.	
	Buckwheat .....		Bu.				Broom Corn.....		Lbs.	
20. HAY AND FORAGE.	Flaxseed.....		Bu.			22. SUGAR.	Peanuts.....		Bu.	
	Kaffir corn.....	X	Tons				Dry beans.....		Bu.	
	Clover Seed.....	X	Bu.				Dry pease.....		Bu.	
	Grass seed.....	X	Bu.				Potatoes .....		Bu.	
	Wild, salt, or prairie grasses.....		Tons		X		Sweet potatoes and yams.....		Bu.	
	Millet and Hungarian grasses.....		Tons		X		.....			
	Alfalfa or Lucerne.....		Tons		X		.....			
	Clover .....		Tons		X		Sugar.....	X	Lbs.	
	Other tame and cultivated grasses.....		Tons		X		Molasses or Syrup...	X	Gals.	
	Grains cut green for hay.....		Tons		X		Sorghum .....	X	Gals.	
	Forage crops.....		Tons		X		QUANTITIES			
	Total hay and forage						Sugar Cane.....		Tons	

SCHEDULE NO. 2—AGRICULTURE.

PERSONS CONDUCTING FARM.	2. POST-OFFICE.	3. COLOR OF RACE.	4. TENURE.

is conducted by a tenant, or by a salaried superintendent or overseer, report in the blank spaces which follow the name and of the person, firm, corporation, or institution owning the farm.

Post-office address

er of acres, June 1, 1900, in farm outlying or separate meadows, pas- ts, marshes, etc.) .....	13. Value, June 1, 1900, of all implements and ma- chinery belonging to the farm (including all ordi- nary implements, all wagons, carriages, sleighs, harness, etc., and all apparatus for making butter and cheese, for ginning cotton, for making cider, wine, sugar, molasses, and sorghum, for drying fruit, and for threshing grain, or for similar pur- poses, together with the engines and other motors for propelling the same). .....\$
res, June 1, 1900, of unimproved land ich has never been plowed, mown or uding land once cultivated but now rees and shrubs).....	14. Estimated value of all farm products (sold, con- sumed, or on hand) for 1899.....\$
res, June 1, 1900, of improved land not reported as unimproved).....	15. Amount expended in 1899 for fertilizers.....\$
res in this farm, June 1, 1900, owned ant.....	16. Amount expended in 1899 for farm labor (exclusive of housework), including the value of board fur- nished.....\$
res rented or leased, June 1, 1900..	17. Number of acres irrigated in 1899, by ditches from natural streams.....
umber of acres reported for question 6 should equal the total of and 8, and also the total of those reported for 9 and 10.	18. Number of acres irrigated in 1899, by pumped or artesian well water.....
r, 1900, of entire farm (including all sed land contained therein, together e of the buildings and other perma- nements).....\$	
, 1900, of all the buildings on the	
\$	

## GENERAL FARM PRODUCTS OF 1899.

CROPS.	ACRES HARVESTED.	QUANTITIES PRODUCED.		VALUES OF PRODUCTS.
		Bu.	Shelled Corn	\$
		Bu.	Corn in the Ear	
		Bu.		
		Bu.		
		Bu.		
		Bu.		
		Bu.		
		Tons		
	X	Bu.		
	X	Bu.		
For prairie		Tons		X
Hungary		Tons		X
Lucerne.		Tons		X
		Tons		X
and cul-		Tons		X
grasses..		Tons		X
green for		Tons		X
		Tons		X
ps.....		Tons		X
nd forage				

  

FARM PRODUCTS.	ACRES HARVESTED.	QUANTITIES PRODUCED.		VALUES OF PRODUCTS.
		Lbs.		\$
Cotton.....		Bales		
Rice.....		Lbs.		
Tobacco.....		Lbs.		
Hemp.....		Lbs.		
Hops .....		Lbs.		
Broom Corn.....		Lbs.		
Peanuts.....		Bu.		
Dry beans.....		Bu.		
Dry pease.....		Bu.		
Potatoes .....		Bu.		
Sweet potatoes and yams.....		Bu.		
.....				
.....				

21. MISCELLANEOUS CROPS.

  

FARM PRODUCTS.	ACRES HARVESTED.	QUANTITIES PRODUCED.		VALUES OF PRODUCTS.
Sugar.....	X	Lbs.		
Molases or Syrup....	X	Gals.		
Sorghum .....	X	Gals.		
		QUANTITIES SOLD.		AMOUNTS RECEIVED.
Sugar Cane.....		Tons		

22. SUGAR.

(a) It was stated that the complex character of the census schedule furnished a great stumbling-block to the enumerator. In order that the reader may judge for himself of the degree of justice of this complaint, the accompanying facsimile of the agricultural page of the schedule is submitted.

It will be seen from an analysis of this page that the reports required from the enumerators cover two periods of time. The men had to ask for reports of the size and value of each farm and its general condition under its occupant in June, 1900. Secondly, they had to obtain returns for the entire crop of each farm for 1899. It is clear that when there had been changes in the occupancy of the farm, either through alterations in tenancy or through death of the owner, or through sale to another owner, the only source of immediate information would be the farmers in the neighborhood. Frequently, several farms existing in 1899 would have been brought together in 1900, or a large farm would have been subdivided into several parts.

(b) Enumerators are, as a general rule, far from being the most intelligent class in the community. They had had little personal instruction, but had merely received a large pamphlet containing detailed rules as to the conduct of the work. They were obliged to deal with men who were not in the habit of keeping books and who were often suspicious and unfriendly toward strangers. The enumerators were badly paid, and that, too, in a year of plenty when work was abundant. Many of them did not understand the meaning of the schedule. Others did not feel sufficiently well compensated for its proper treatment.

(c) It was maintained by critics of the census that the way prescribed for classifying farms tended to exaggeration. No agricultural census until the present had considered any tract of land to be a farm for census purposes unless it contained at least three acres or produced, during the census year, a crop of a certain minimum value. In the twelfth census this definition was altered. Anything was held to be a farm which required the entire time of at least one person in its cultivation. Such a definition naturally took in many country estates, as well as institutions of all kinds with which a farm was connected.

Formerly, the value of buildings on country estates, as well as institutions and land not used for agricultural purposes, had never been included in making up farm values. To add these values and to change the definition of a farm, as was done in the present census, it was maintained, would account for a vast increase in the value of farms reported by the census for 1900.

(*d*) The book of instructions supplied to enumerators had directed them to fill out farm schedules that necessarily led to duplications. Those instructions separated farms into two distinct classes: (1) Those operated by farmers, either owners or tenants, residing upon the same; and (2) those consisting of tracts of agricultural land with no farmers residing thereupon. With reference to the first of these classes, the instructions directed the enumerators to report the whole farm in the enumeration district in which the farm house was located. Tracts of agricultural land with the cultivators residing in the enumeration district in which the land was located, but not upon the land cultivated, were to be similarly reported. But such tracts of land cultivated by farmers residing in different districts were to be specially reported, as follows: The enumerator in the district where the land was situated, and the one in the district where the farmer resided, were both instructed to report the farm, and both were directed to mark upon the schedules the word "non-resident." If both enumerators followed instructions there would be two reports of the farm, and the duplication would be detected in the office and one of the schedules canceled, provided only that the office work of the census was properly conducted. In like manner, under any correct system of office work, all such duplications would have been detected had only one of the two enumerators marked his schedule as directed. But if both of them should report a "non-resident" farm, and both disobey the instructions to write the word "non-resident" upon the schedule, the office would have no means of detecting the duplication. It was charged that there must have been many such duplications, and that owing to a failure properly to check the schedules marked "non-resident," there were many other similar duplications.

(*e*) Further, it was charged that even when the word "non-resident" appeared in the proper place, it often happened that the two duplicate reports would differ as to the size of the farm and frequently also as to crops. Under these circumstances, it was sometimes taken for granted that the enumerator had reported only that portion of the farm which lay in his district, and the schedules were combined to secure a report of the entire farm. In some cases, however, it later appeared through correspondence that the enumerator for the district in which the farmer lived had reported the entire farm. The absence of information upon some of the schedules, however, often left the clerks in doubt whether to combine the schedules or to throw out one because it was included in the other.

(*f*) Again, where individuals were absentee managers, reports were not to be secured from them. Enumerators, however, often obtained reports from owners and not from operators, and thus sometimes two reports of the same farm were turned in. Of course, this error could not be detected when the schedule seemed to be correct, and when it was not stated thereon that the farm was in a different district or was operated by someone other than the owner. Thus, occasionally, enumerators in Illinois may have reported farms in distant states because the owner lived in their district. In many cases, of course, they stated that the farm was situated elsewhere, and the mistake was then easy of correction. It is, however, clear that many enumerators probably did not state this fact.

(*g*) In questions 9 and 10 on the schedule, as above given, it will be observed that a request was made for the number of acres owned and for the number leased. The intention of those who prepared the schedule was that question 10 should be answered by giving the number of acres leased by the operator of the farm from others, and not to others. In case a man cultivated half his own farm and rented half to others, then question 9 alone should have been answered upon his schedule. The other half should have been reported by the individual who leased it from him. Yet in numerous instances enumerators reported one-half the total acreage owned by this individual in



answering both question 9 and question 10. It would then appear that the proprietor owned only half as much as was actually the case, while he leased the same amount from someone else and operated it himself. Thus a complicated error would be produced which could be corrected only in case a census clerk was keenly on the alert and happened to find the schedule returned for the tenant who leased one-half of the owner's farm, in the supposed case. On such a schedule, presumably, the real owner would be represented as the actual owner. Even in this case, however, it would be very difficult to straighten out the tangle produced by careless enumeration.

(*h*) The fact that the questions on the schedule related to two distinct periods of time was, as has been intimated, something of an obstacle to correct work by the enumerators. In some cases, farmers did not report to the enumerators the crops raised by them in 1899 on the farm they occupied at the time of the enumeration, but reported crops raised by them on other farms which they occupied in 1899.

Hence, a discrepancy was frequently created between the number of acres given in the first and second parts of the schedule respectively. It was charged that these reports, however, were ordinarily accepted. Of course, in cases where farmers who had moved north from the south reported cotton raised by them in 1899, so extreme an absurdity was produced that the schedules had to be rejected. Somewhat similar to this difficulty was that which occurred in the southern states, where many large plantations are subdivided on a lease system among tenants who again sublet to subtenants. It sometimes occurred that an owner would report the whole of his land whether leased or not, and that then the tenants would report their land and the subtenants theirs, so that there were three sets of reports covering the same ground. As it was often difficult or even impossible to find out how many acres the owners had retained for their personal use, it could not be ascertained what proportion of the estates was three times reported, or whether some portions were reported only twice or only once.

In addition to these sources of error specially charged against

the enumerators for the twelfth census, there were, of course, the usual number of blunders due merely to stupidity and carelessness. Of course, the schedules were full of mistakes made evident by inconsistent statements concerning returns of acreage, for products, and for values. All these blunders, as well as those set forth above, could be corrected only in the office.

Of the eight specific charges above cited against the field work of the census it may be remarked in passing that the census authorities declared in reply that so far as they were true those referred to under (*a*), (*b*), (*f*), (*g*), and (*h*), applied with greater force to all preceding censuses, although in one case in a slightly different form. Over 1,000,000 acres duplicated between owners and tenants were discovered and rejected, the arrangement of the schedule for the twelfth census facilitating this in a manner that no other schedules had, while the form of the schedule also facilitated the detection of lands leased to others and belonging to the main farm. The census authorities also pointed to the tables of their printed report in support of their declaration that the value of all farms under three acres, referred to in (*c*), included by the new instructions of the twelfth census were only .3 per cent. of all farm value, and that the total addition to the crop acreage affected thereby was less than .1 per cent. They said that the non-resident schedules for which no duplication was found, as charged in (*d*), by careful investigation were found to have an acreage of less than one-tenth of one per cent. of all farm acreage, and that no consolidation of non-resident farms ever took place as charged in (*e*).

Thus far of the outdoor, or "field" work of the census. It is now time to turn to the indoor, or office, work. We have seen that the charges against this part of the work of the census covered two special counts in the indictment—the actual work of editing and correcting the schedules and the mechanical or machine work by which the process of counting and tabulating was performed.

In dealing with these questions it is most convenient first to speak of the process of editing the schedules. This process, of course, was intended to harmonize the discrepant returns sent in

on the schedules, wherever vitiated by the errors already spoken of. It is evident that, could this process have been perfectly performed, there would be nothing in those criticisms of the work of the enumerators which have not already been described. It is equally clear, however, that no such work of editing could be perfectly performed. Errors might arise in two ways :

1. They might simply be perpetuated from the mistakes made by the enumerators, as just described.
2. They might be fresh errors brought about by faulty methods of editing.

Of course, the most obvious way of correcting a schedule which on its face appeared to be incorrect would be to write either to the enumerator who made it out or to the farmer to whom it related, asking for true information on disputed points. It is equally manifest, however, that such a process had its obvious limitations. The total number of schedules was somewhere in the neighborhood of six millions. It has been charged by some that the percentage of these schedules which might be set down as absolutely correct did not exceed twenty-five. This would have left 4,500,000 inquiries to be made by letter—a task much greater than the taking of a new census. Evidently some other means had to be resorted to. In certain instances, where it was impossible to get schedules into satisfactory condition, letters of the kind referred to were in fact directly written. Many thousands of such letters were sent out, but in the majority of cases, it was claimed by critics, the correction was made by mere reference to what appeared to be the manifest facts in the case. Some errors could, on the face of things, be at once and very certainly set straight. But there were others in which no such simple and easy road to correction could be found. In such instances it was necessary to resort to tables of averages and maximums and minimums relating to products and prices prepared in advance for each county in each state. These averages were obtained by correspondence with prominent men in the region in question. Then, in case an inquiry direct to a given farmer was not answered, or in case it was not thought worth while to send out an inquiry, or in case

time pressed, correction would be made by reference to the tables and the schedule figures would be arbitrarily changed. It was charged that the rules enforced upon employees and the methods by which the averages were made up were of such a character as always to result in taking the largest available figure where any doubt existed. It was answered by the census officers that these methods and rules always resulted in taking the smallest. We might continue with a more elaborate criticism of the methods of editing, but what has been said suffices to show the drift of current discussion on the subject. One observation, however, deserves to be made: it was impossible for any member of the force to know all the details of the extensive and intricate system by which the work of editing was carried on. This will be apparent from a review of the different steps in taking and comparing the census figures as outlined in a former article.<sup>1</sup>

Turning now to the other class of criticisms—those which relate to the mechanical portion of the work done in the office—a problem of equal complexity is presented. The mechanical work consisted of two main parts—the punching and the tabulating. These must be described before they can be discussed. The first process—that of punching—was a mechanical device for recording the results of the schedules upon cards in such a way that they could be counted and tabulated by mechanical means. A different kind of card was used for each crop, and each card contained subdivisions designated by symbols each of which indicated acreage, product, and value of each separate crop raised. This made it necessary that each clerk should memorize a large number of symbols in order that they might know how to reproduce the facts taken from the schedules in a symbolical way on each card. The accompanying insert is a facsimile of the crop card used, and it will be seen from the words printed on the face of the card what each subdivision was for. Of course, the words did not appear on the cards actually used and are only reproduced here for clearness' sake. The exact process of punching these cards can be understood

<sup>1</sup> See this JOURNAL, December, 1902, pp. 10-12.

best from the instructions to punchers, which are herewith reproduced:

#### INSTRUCTIONS FOR PUNCHING CROP CARDS.

The foregoing is an accurate reproduction of the crop card, except that the words designating the purpose of the separate fields have been added.

The word "field" is the term used for each principal division of the card.

Each crop, animal, or product is designated by a separate number, which can be found in this exhibit, and a separate card is to be used for each. This number is called, for any crop, etc., its symbol, and is to be punched in the field designated "crop number." When a schedule contains any data for which no symbol is provided in this exhibit, bring the matter to the attention of your section chief.

In punching crops, unless some other specific instruction is given, the acres and numbers of trees or vines are always to be punched in the field designated "acres," the quantities produced in the field "quantity of product," and the values of the same in the field designated "value of product." The number and value of animals are to be punched in the fields designated for these items.

In punching for crops, products, and animals, always give exact figures for acres, number of trees, vines, and animals, also for values. For the quantities of crops and products give exact figures with the following exceptions:

Omit the unit figure for the bushels or centals of corn, oats, wheat, rye, barley, buckwheat, and flax seed, for all crops and products reported in pounds, quarts, heads, number (except number of trees, vines, animals, fleeces, and swarms of bees), dozens, or bunches. Omit the unit and tens figures in reporting the pounds of sugar in Louisiana, Texas, and Florida, and for all states omit the unit and tens figures for the pounds of hops produced, the gallons of milk produced and sold, and pounds of grapes produced.

When the unit figures are not punched, if the final figure is either 1, 2, 3, or 4, no change is to be made in the next preceding figure, but where the final figure is 6, 7, 8, or 9, the preceding figure should be increased by one. For example, if the amount reported is 924, punch 92, but if the amount reported is 926, punch 93. If unit figure is 5, no change should be made in the next preceding figure provided it is even, but if odd, it should be increased by one. A corresponding disposition should be made of the fractional parts of a hundred when unit and tens figures are disregarded.

The fields are to be punched in the regular order by touching the keys indicated from left to right, and one digit in each column in each field must be punched, except that when no amount is stated in answer to any question on schedule, and an "X" appears at the top of the field provided for such question, the "X" should be punched in lieu of separate digits. If there is no "X" at the top of the field, then successive ciphers (0) should be punched.

When the amount to be punched will not occupy the entire field, punch ciphers (0) at the left of the significant figures.

When an amount is found for any field which requires more figures than can be punched in the columns provided, punch that portion for which columns are available and use a specially prepared extra card, with red ends, for the remainder. Give the extra card the number of the card to which it relates and punch the proper figures in the first three fields, the extra figures in the appropriate fields, and in all other fields strike "X" keys or punch ciphers.

TWELFTH CENSUS  
OF THE  
UNITED STATES.

## AGRICULTURE.

[illegible]

When a red end card, to be used as above, is the card for an irrigated crop, or animals on the range, use a red end card with green on top edge.

Whenever the word "Range" is stamped in red on a schedule use a red card for animals, but not for crops.

Whenever the letter "I" appears before the name of any crop on page two or three, it indicates an irrigated product which should be punched on a red card.

On the lower left hand margin of page two of each schedule, write the numbers of the first crop card punched for each schedule. When red cards are used for irrigated crops or range animals, write the number of the first of such cards used, as above stated, in addition to the number of other cards, if any such are employed. Draw line under number of red cards. For range animals use the numbered red card.

Where there are any data in 37 of the schedule, or where there is any irrigated crop reported in the states east of the Mississippi, use the unnumbered red card, giving it the number of the schedule. No white numbered card should be thrown out because of the use of a red card.

SIZE OF FARM: Punch figures on margin under word "Size."

SOURCE OF INCOME: Punch figures on margin under abbreviation "CHTR."

If no figures appear under the characters "Size," "CHTR," or "Amt.," bring the matter to the attention of your section chief and have index figures inserted.

The machine used for doing the punching somewhat resembled a typewriter in external appearance.

It now appears that in performing the punching process a clerk must first learn a considerable number of arbitrary symbols, must then glance at the schedules, mentally translate the census returns into symbols, insert a card of the proper kind into the machine, and record thereon the proper symbol. It goes without saying that such a process required some exercise of the powers of memory as well as a certain degree of mechanical dexterity. When we consider the number of errors made by stenographers, it is clear that an equal number of errors in recording symbols would seriously vitiate the census returns. It was charged by those who attacked census methods that exactly these errors had occurred. Of course, the only way of guarding against such errors would have been to see to it that those who did the work were trained and skilled in the occupation, and that their work was verified. The first of these safeguards could not be claimed by the Census Bureau, for the clerks were chiefly political appointees, chosen without regard to fitness and at the outset wholly unskilled in any work of the kind. The only protection, therefore, remaining was that of verification. The census

officers stated that every employee's work was verified, until it appeared that that employee was able to keep the number of errors down to  $1\frac{1}{2}$  per cent., *i. e.*, had become experts. After that point had been reached, only 5 per cent. of the employee's cards were verified, and if in these cards the errors found aggregated more than  $1\frac{1}{2}$  per cent. of the total cards thus examined, the employee was subjected to a more rigid examination. It was charged by critics that through the unfaithful fulfilment of this process many errors crept in. They specially deprecated the custom employed in the census office of fixing the salaries of employees in accordance with the speed attained by them. It was answered by the census officers that errors were guarded against by the process of verification already described. But this was not all. They further claimed that by an additional process of verification all errors of a serious character were later detected. An inspection of the crop card, as already given above, shows that if cards of certain classes should be grouped together—all belonging to one class in one package, all those to another in another, etc.—the perforations would be uniform to a certain extent; that is to say, the holes punched would be directly superimposed. Now, after the cards had been grouped in this way, knitting needles were run through holes in the cards and thus, where the holes did not extend entirely through a stack of cards, it appeared that some cards of a different class had erroneously been included. These could then be sorted out and due correction made. This correction, of course, came at a later point, as will be seen.

The complaints concerning the mechanical work of the census did not stop with the criticism of the punching process. This criticism was extended to the process of tabulation as well. The work of tabulating was done by the use of tabulating machines worked by electric power. Cards were fed into the machines and an electric contact was made through the holes in the cards. This electric circuit when made was recorded on a dial. The ringing of a bell and the passage of an electric spark indicated to the operator that the card had been registered. Cards which were not registered were thrown out into a box for examination



in order to see why the electric contact or circuit had not been made in their case. They were then repunched. The complaint was made that in working these machines registration often failed to occur through difficulties in manipulation. It was said there was no way of proving the returns obtained except by running the cards through the machines a second time. When this was done, it was charged, the same results were very seldom secured from the machine twice in succession. It was after the first run through the machine that the knitting-needle verification already described was made. In case this process of verification turned out to be correct, the machine results were compared with the general average for yields already known by inquiry as characteristic of the region represented by the cards. In case there was a general correspondence, and in case the knitting-needle test turned out satisfactorily, results were accepted. Occasionally a set of cards was run through the machine again. The process thus far had been a process of tabulation by counties. After it was finished the cards were again sorted in accordance with the race of the farmers, then in accordance with their tenure, then according to the character of the farm, and finally according to the size of the farm. Thus the same cards were counted four times. The results should have been the same in every case for each state, since the same cards were used. It often happened, however, that there was no similarity between the results thus obtained. In examining these discrepancies it turned out that they were in some instances due to the use of "trailers" in place of original cards. These trailers were cards with red edges, intended to take the place of original cards only when the figures on a schedule were too large to be recorded upon cards of the ordinary type. The units' place on trailers meant 1,000 or 10,000, and thus, when these cards were accidentally used in place of the original cards, the results were multiplied by 1,000 or 10,000. While most of these mistakes could be eliminated in the process of tabulation, it was charged that in many cases that result was not attained.

Further complaint was made of the work in the division of final results. In this part of the office an effort was made to

correct the returns yielded by the machines. Here the tables of maximums and minimums again came into play. Figures, it was said, were reduced or raised to harmonize with these pre-conceived standards. What seemed to be manifest absurdities were eliminated. While it was conceded that the work was done with great care, the claim was strongly made that to trace apparent errors back through the different processes was nearly impossible. In a final process the results were again closely examined, compared with the results of previous censuses, and, if they seemed to be too much out of harmony, were altered again. In one case, it was claimed, where the Division of Manufactures and the Division of Agriculture of the census had prepared bulletins treating of the same subject, the results obtained were so different that it would have been absurd to publish the two as the work of the same bureau.

Looked at superficially, this long list of charges appears like a most serious indictment of the work done in the Census Bureau. It is necessary, however, to consider and analyze the figures with more care. This will be done at a later point in this discussion, after we have reviewed the work of the investigating committee which later came to Washington to examine into the relative accuracy of the work of the census and the Agricultural Department. For the present it is sufficient to note a few general considerations.

1. That in any large statistical undertaking, multitudes of errors are absolutely certain to make their appearance.
2. That the whole question as to the efficiency of the Census Bureau in this instance, both absolutely and in comparison with that of the Agricultural Department, depends upon two factors. It rests upon the margin of possible or probable error and the extent of that error as compared with a similar factor in preceding censuses, on which have been based all estimates of the Department of Agriculture prior to 1902. No direct evidence has been submitted to show that there were more errors either in field work or in editing in the recent census than there were in its predecessors.
3. That the census officers were able to show at nearly every

point some corrective, which they claimed was sufficient to offset the chances of error pointed out by critics.

## II.

The controversy between the partisans of the two statistical offices had been threatening for several months before the final results of the twelfth census became officially known. During the spring and early summer of 1902, the discussion became sharp. Sides were chosen by most government statisticians, and it was felt that steps must be taken with a view to setting matters straight, and determining to which set of statistics credence should be accorded. The great problem was how to secure a proper investigation. It was out of the question to expect that the secretaries of the two departments involved would take an active interest in the matter. Much as they might wish to see the question settled, too much was at stake to permit them to rush into an investigation without fully weighing all the issues. It might be expected that the investigation would result in a definite verdict for one set of figures or the other. If so, discredit would be reflected upon the losing side. Moreover, points of official courtesy of vastly larger importance than the welfare of the whole world were at stake. All this was early perceived. The two main parties to the controversy adopted very different points of view. At the census office there appeared from the outset to be a strong feeling in favor of an investigation. At the Agricultural Department, on the contrary, men appeared to be either indifferent or adverse to close inquiry. With only a one-sided willingness to proceed, therefore, there seemed to be small prospect of reaching any immediate results. The first definite impulse toward investigation seems to have been given by Hon. L. G. Powers, chief statistician for agriculture in the Census Bureau, who in answering a statistical inquiry addressed to him by Mr. J. C. Brown, the statistician of the New York Produce Exchange, expressed a strong desire to have the questions at issue investigated by representatives of the boards of trade of the country.

Mr. Powers furthermore urged the importance of such a step

in letters to other well-known men. Although several felt considerable interest in the idea of a crop inquiry, nothing practical was done until the matter was brought to the attention of some members of the National Board of Trade. These men undertook to have the discrepancies, already so notorious, investigated by the "Crop Reports Committee" of the board of trade. After much correspondence, that committee appointed a subcommittee, and it was agreed with the census authorities that the office should be opened for inspection. More difficulty was experienced in getting the Agricultural Department to yield the same consent, but Secretary Wilson finally signified his willingness to have the Division of Statistics examined by the visitors. It was desired to have the inquiry take place during the latter part of June. Had it occurred at that time, the census office would have been able to place at the disposal of the committee a considerable number of the clerks who were members of the temporary force and who were discharged after July 1, when the bureau became permanent. This, however, was not possible, owing partly to the delay of Secretary Wilson. The date for the meeting of the committee was finally fixed at the middle of September, and on the 15th of that month the members convened in Washington. There were present Mr. William S. Harvey, representing the Philadelphia Commercial Museum; J. C. Brown, from the New York Produce Exchange; B. Frank Howard, from the Chicago Board of Trade; H. A. Wroth, from the Baltimore Chamber of Commerce; and Charles B. Murray, from the Cincinnati Chamber of Commerce. Mr. William V. King was also present from the New York Cotton Exchange, but was called away from the deliberations almost at the very outset. With the investigators came Mr. Blanchard Randall, the president of the National Board of Trade. Mr. Randall was present only during a part of the first day's session.

From the outset the crop statistics committee manifested a point of view which was as unfortunate as it was arbitrary. It would appear that the committee had originally intended that its sessions should be held in public. Nothing, it is true, had been definitely stated on this topic. Inquiry prior to the assem-

bling of the committee showed that none of those most intimately concerned had any official information on the question of publicity. Yet the fact that nothing had been said to the contrary was taken to indicate that the committee intended to pursue the usual custom, and that it recognized the necessity of having its doings carefully reported through the public press. Mr. Powers had in fact invited the committee to a public investigation, saying to those who inquired that it would be open to the newspaper world. He had invited such an investigation only. It was distinctly stated by some of those who were directly interested that the inquiry would be followed legitimately and thoroughly, and that the business world would be enabled to check the doings of the committee day by day. Nor was this expectation based solely upon inference. At the first session of the committee, held September 15, at the census office, Mr. Blanchard Randall, the president of the National Board of Trade, under whose auspices the inquiry was being conducted, made the statement that it was his wish as an officer of that body that the press of the country should be represented at the sessions and that the widest possible publicity should be accorded to the proceedings. Thus the public character of the investigation as specified in Mr. Powers's original invitation was recognized. Pursuant to this wish on the part of Mr. Randall, the first session was nominally public. On the following day, however, the committee visited the Agricultural Department. It was precisely there that publicity was most necessary and would yield the most beneficial results. Enough was already known of the methods employed by the Census Bureau. That office had never manifested a disposition to insist on secrecy, but had always offered to the public every facility for making acquaintance with its methods. The reverse policy had been pursued by the department, and it had been hoped that the inquiry would furnish opportunity for learning the truth concerning some of the methods which had been so long hidden under a mask of concealment. It was therefore with some surprise, not to say disappointment, that the public learned of a change in the committee's intentions. Scarcely had the members undertaken work

at the department when it was given out that no representatives of the press would be permitted to attend the investigation, and that nothing would be made known concerning the outcome of the inquiry until an official report was rendered.

This determination was religiously lived up to. What had operated to change the minds of the committee; what had led its members to reverse the opinion of President Randall, has never been stated. What hypnotic influence was exerted over some or all of the members of the committee, and from what sources it originated, if from any, can only be imagined. It is certain that little or nothing was given out by the members during their stay in Washington, or thereafter. The task of investigating the worth of our agricultural statistics did not prove to be an easy one. About ten days were consumed in visits to the Census Bureau, the Agricultural Department, and the Weather Bureau, before the committee felt that it had accumulated a sufficient fund of information to justify it in beginning the task of drafting a report. Moreover, several members were obliged, for business or other reasons, to be absent during considerable periods even of these ten days, and it finally resulted that the work of drafting the report was practically placed in the hands of a sub-committee.

While it was true that nothing of an official character could be learned concerning the deliberations of the committee, subsequent to the time when the doors of the investigation were closed, inquiries addressed by those engaged in drafting the report to statisticians in Washington indicated either that there was dissension among the members regarding the proper drift to be given to the report, or else that the members were at sea with regard to some important details concerning the methods of compilation employed in the preparation of the government statistics. The report, in fact, did not make its appearance until November 24. On that date it was published in the morning newspapers and was received by some of those who had been parties to the controversy. There had, however, been some preliminary announcements of an unofficial sort concerning the nature of the material to be contained in the report. More than a

month before it appeared the statement had been made at the Agricultural Department that an immense mass of material relating to the census had been placed by officers of the department in the hands of the investigating committee, and it was freely predicted that the report would, in consequence of the information thus presented, be strongly adverse to the census. This suggestion was scouted by those who were conversant with the situation. It was believed that the danger involved in such a proceeding was too great, the violation of official courtesy too open and too serious for the Agricultural Department to be guilty of, or the crop statistics committee to be a party to, such a proceeding. It seems almost incredible that such could actually have been the case. Yet there are facts bearing on the situation which cannot be neglected. It would appear that a knowledge of the nature of the report was at all events possessed by some officers of the Agricultural Department before the document reached the Census Bureau. Not only were the predictions made by these officers strikingly fulfilled in the actual character of the report, but there seems to be ground for the belief that special information concerning it was furnished by some official person to certain newspaper correspondents on the night before the document was to have made its appearance in print. Certain newspapers did at all events print, on the morning of November 24, articles containing information of the same general character as was given in the report itself, but going very much beyond that document in specifying the basis for the criticisms of the census figures which were thus given to the world. Nor was a previous knowledge of the nature of the report openly denied by those who had already predicted its character.

It is not, however, with the details of this by-play that the student of the statistical question is primarily concerned. The center of interest in the history of the crop statistics committee is, after all, the contents of its report, and not any doubtful methods that it or its members may, or may not, have employed. The important features of its work lay in the fact that it largely exonerated the Agricultural Department from the charges which

had been made against its statistics; that it called in question in serious fashion the accuracy of the work done in the census office; and that it recommended action by Congress, looking to the enlargement of the statistical work of the Agricultural Department rather than to its curtailment. Thus the committee gave the lie to the charges made against the department, and, in the face of the opinions of the most competent men, it, by inference at least, affirmed a belief in its work rather than in that of the Census Bureau. Owing to the prestige enjoyed by the committee in consequence of its position as the representative of the National Board of Trade, it is deemed best to avoid all possibility of mistaking its views by giving in the words of the report the conditions that it found to exist and the remedies that it prescribed for past evils.

Of the situation at the Census Bureau the committee wrote as follows :

As a result of investigations and deliberations in regard to the work of the Division of Agriculture of the Census Bureau, the committee has reached the following conclusions :

1. The preparation of the census schedule relating to agricultural data was unavoidably complex, under the demand for information upon a wide range and various divisions of subjects.

2. The schedule was evidently formulated by the best judgment available, representing a high degree of intelligence on the part of its constructors in regard to questions involved and of requirements of the situation.

3. The executive direction of the statistical work appears to have been in charge of persons of a high order of competency, while the operatives and those in supervision of their work by sections were not selected and retained through tests of qualification under the system by which such persons were appointed to service. The executive officials were without power to dismiss unsatisfactory operatives, but they were enabled to transfer persons from work to which they were found to be not competent, or not adapted, to other work more suitable to their qualifications. Thus, it was held by the statistician that the political relation to the selection of the great number of operatives had little or no appreciable influence unfavorably affecting statistical results.

4. The basis for errors in the census agricultural statistics included inability or failure on the part of farmers in many instances to accurately state or report the information called for; incompetency of enumerators in their ability to make accurate and full records on the



schedules; lack of needful knowledge on the part of supervisors to enable them to discover all defectiveness in the schedules—these factors representing the prominent primary elements or grounds for error.

5. The work of collating and tabulating the information reported on the schedules was attended with opportunities for error in editing the schedules for guidance of card punching; in editing to correct evident mistakes, deficiencies, or inconsistencies in schedule record in the work of punching the cards used for registration; in disordered condition of tabulating machines; in careless work of operators of tabulating machines, including duplication or repetition of registration; in copying totals from the machine dials to result sheets and to consolidation sheets, and in the work of totalizing.

6. In carrying out the work of collating and tabulating such information no certainty of strict accuracy of results can be had otherwise than by duplicating operations and comparisons, following the lines of difference until like results have been reached.

7. It has not been possible for the committee to determine the extent to which errors in the returns and in the various processes of the statistical work have affected the results reached or have furnished occasion for regarding the general conclusions as undeserving of confidence as being within reasonable approach to accuracy, or as essentially less accurate than should be expected from the application of best-known methods for accomplishment of work of such magnitude and comprehensiveness within the time imposed by Congress for its completion.

8. The causes for the surprises and elements of doubt which have arisen on the part of the interested observers in regard to the census agricultural statistics have not been altogether attributable to imperfect or erroneous work in this branch of governmental service, but largely to comparisons made with other official exhibits, governmental and state, constructed on lines more or less seriously faulty, and which have led to results at corresponding variance with accuracy.

The committee regards it important that in the future work of the Census Bureau the various defects found in the methods pursued in the twelfth census in the collection and presentation of agricultural statistics should be remedied. These features include the following :

1. In all the more important districts the supervisors should institute schools for instruction of enumerators, to the end that the fullest possible understanding shall be had of the requirements for correct records on the schedules, thus securing a high degree of accuracy in the primary basis for such statistics.

2. In the editing of schedules greater care should be had in having the clerk well qualified by fitness and training for such work, for in this feature is one of the most significant of possibilities for harmful shaping

of the results, and therefore one of the greatest of needs for careful and intelligent scrutiny and preparation of this record as a basis for compiling and tabulating operations.

3. The verification of cards prepared for the tabulating machines, including the mechanical tests for cards, should be accomplished before instead of after the machine tabulation, and a larger proportion than heretofore of all the cards should be verified by the schedules.

4. The more important crop data should be tabulated in duplicate, to prove the accuracy of the work.

The committee recognizes the achievements of the Census Bureau in completing its work within a period of two years as a matter of great importance relative to the value of such information, and regards with satisfaction the assurance of the chief statistician for agriculture that the experience had in the twelfth census work gives encouragement to the expectation that improved methods can be introduced at the next census making it possible to reach conclusions within a period of eight months, and that the progress of operations of the past census has been educational to an extent insuring great improvement in features of accuracy of such future statistical work.

In view of the advantages to be expected from the Census Bureau being placed on a permanent basis and of the promise of a shortened period for presentation of results, the committee favors a census report every five years, especially for agricultural data which form a basis for calculations and estimates of area and production by other official service, governmental and otherwise, as to the most prominent crops and to numbers of farm animals.

On the other hand, the committee wrote that :

From investigations and deliberations in regard to the work of the Statistical Division of the Department of Agriculture the committee has reached the following deductions and conclusions :

1. The errors in crop statistics of the Department of Agriculture to have been due more to a faulty area basis than to any other cause.

2. The present statistician appears to have earnestly endeavored to secure correction of the errors in the area basis of crops, but as late as 1901 he had manifestly not fully overcome the deficiencies in this particular which existed when he entered upon the work of his office. The stated proportions of a crop when based on percentage calculations are a misrepresentation to such extent as the area basis is erroneous.

3. In readjusting the area basis during the current year the statistician has accepted the Census Bureau returns with such exceptions wherein there was deemed ground for modification in the light of other evidence.

4. The Statistical Division is more or less embarrassed, and seemingly to an important degree, by the manner in which the working force of the office is organized under political influences, making it impractic-

cable for the statistician to reconstruct the service on a basis of qualification and efficiency.

5. While the percentage system used by the Department of Agriculture cannot be depended upon for the fullest degree of accuracy of reported results, it is undoubtedly the best practical system available for purposes of monthly and yearly reports. It needs to be applied with an intelligent understanding of its true meaning and significance.

With reference to the future operations of the Statistical Division of the Department of Agriculture the committee submits the following propositions and recommendations:

1. The work of the Statistical Division is of such importance to the agricultural interests of our country, and to commercial affairs in the transactions of tradesmen in this and other countries, that the committee is impelled to urge the honorable secretary of agriculture to give his favorable consideration to the need of securing for this branch of governmental service the strength and power of a bureau, at the earliest date practicable, with an increased appropriation if necessary, and that he lend his full influence for the attainment of this end.

2. The working force under the statistician, including state agents, should be thoroughly reorganized on a sound business basis, recognizing qualification and giving certainty of efficiency in such service.

3. The committee unqualifiedly declares it inadvisable to entertain any plan for transfer of the work of the Statistical Division to any other branch of the government service, regarding it of great importance that it should have and should maintain distinctive powers.

4. In the crop-reporting work, the important aid which has been secured through the service of special field agents supports the view that there should be an increase in such service, to the extent of twelve or fifteen persons as a total number, with a chief in general charge, having direction of such branch of service.

5. In addition to the present method of inquiry as to comparative crop area on a percentage estimate, it is recommended that the statistician also provide in the schedules an inquiry for acreage estimates, for the important crops, requesting the correspondents to invariably furnish this information, which will serve as an important guide in reaching conclusions.

6. The method of reporting winter wheat and spring wheat conditions separately a portion of the season and subsequently as consolidated should be so changed that such exhibits shall be given separately and consolidatedly to the end of the season.

7. In statements of condition and yield of wheat, it is recommended that in specifications of winter and spring grain distinctively the reports recognize areas of states, making the classification in accordance with the predominating characteristics in this particular.

8. The yearly final report of the leading crops by states, giving acreage harvested and production, should be accompanied by a statement indicating the differences between acreage planted and acreage harvested, where there are notable differences.

9. In reporting the estimated areas of crops planted or seeded, the statistician should definitely state the acreage figures as well as percentage comparisons.

It should be observed that in these general findings and recommendations the committee adopted different attitudes towards the Census Bureau and the Agricultural Department. It seemed inclined to apologize for the department, while it adopted a severe, not to say biased, point of view with reference to the census. That being the case, the friends of the census had a right to expect that something more than general charges would be preferred. Yet it will be observed that only general statements were included in the eight formal findings already stated in regard to the bureau. The committee, in fact, expressly stated that "it has not been possible . . . to determine the extent to which errors in the returns and in the various processes . . . have affected the results reached." All that resulted from the formal findings of the committee was, therefore:

1. That there had been errors in the census work.
2. That the committee would like to have such errors remedied.
3. That the committee did not know how far the errors extended.

Of course, conclusions of this kind are as weak as water. No one doubted the existence of mistakes. The whole object of the investigation had been to determine the margin of error in the statistics, and if the inquirers threw no light on that they might as well have remained away from Washington. The unfortunate feature of the committee's work lay in the fact that, while its findings did not assume to give any definite information as to the margin of error, there was an effort in other portions of the report to cast reflections upon the bureau without affording any reason in support of the charges made. All of

the old complaints concerning possible inaccuracies in the census process were repeated,<sup>1</sup> but in few cases did the committee go beyond the mere statement of possibilities. In one instance, however, it did actually bring forward some new information. This information, if correct, would doubtless have told heavily against the census. It consisted in the claim that in many counties the returns on the census for acreage far exceeded the surveyed land area of those counties. The total number of such counties was said to be 101. Moreover, it was claimed that in 700 other counties the returns of the bureau indicated an acreage amounting to 90 per cent. or more of the total land area. This was the sole and only count in the findings of the committee that could throw any new or decisive weight against the accuracy of the census returns. Yet this in itself was quite enough to reflect serious discredit upon the work of the bureau, should it be accepted. It was, therefore, doubly important that the committee should have furnished detailed information concerning so important a charge. This it failed to do.

It was unavoidable that the Census Bureau should feel itself to be directly attacked by the report of the committee. And, as we have seen, the prestige enjoyed by that body is sufficient to make its report seem to superficial observers a decisive rejoinder to the criticisms of the Agricultural Department offered by those most conversant with its methods. For these reasons it is of great moment, not merely to review the action of the Census Bureau, but also to reach definite conclusions concerning the accuracy of the charges preferred.

<sup>1</sup>“An exhibit of the crop cards verified in the census office work during the five months of February to June, inclusive, 1901, and classification of errors found,” wrote the committee, “with percentage of error of each of the fourteen classes and for those unclassified, furnished the following data and results: number of cards verified, 1,230,727; errors found, 16,500; percentage of cards found erroneous, 1.34; average percentage of errors by classes—wrong designation, 7.33 per cent.; not increasing tens digit when omitting major unit, 2.02; increasing tens digit when omitting minor unit, 0.88; error in two figures, 0.16; wrong symbol, 19.34; omitting cards, 25.89; duplicating cards, 2.84; reading wrong line, 1.21; transposing figures, 0.41; wrongly read, 17.15; misspaced, 5.39; digit not cut off, 4.42; digit cut off in error, 2.85; two punches in one column, 2.53; other errors unclassified, 7.58.”

Director Merriam at the very outset gave orders that the specific claims of inaccuracy in the census figures made by the report should be thoroughly investigated. From the committee the list of counties in which errors were alleged was obtained, and an investigation was in fact set on foot, a special force of clerks being assigned to the task. Some six weeks after the work of the committee had become known Director Merriam made public the results of his investigations in the following words:

In order to satisfy himself and the public in regard to the substantial accuracy of the census statistics of agriculture, he has caused a careful retabulation to be made of the enumerators' returns of farm areas for Iowa. The state of Iowa was selected for the test because it is the chief agricultural state with the largest area of improved farm lands, and because it contains 17 of the 102 counties out of the 2,867 of the counties, or equivalent divisions in the United States, in which, according to the report of the committee, the farm acreage, as given by the agricultural census, is in excess of the actual surveyed area, as reported by the census geographer. The reported acres in farms in Iowa, as printed by the census, were 34,574,337, and as retabulated they were 34,488,797, a difference of one-fourth of 1 per cent. for the state. In only one county in nine was the error equal to 1 per cent.

In addition to Iowa the census office has carefully retabulated the returns from each of the 102 counties referred to by the committee, and both the original tabulation and the retabulation have been critically examined by the geographer. As a result of this careful test, and verification of the work, the director reaches the following conclusions:

1. Out of the 102 counties in which it is alleged that the reported area in farms is greater than the entire land surface measured by the geographer, 56 are disposed of by the report of the geographer, who finds the statement regarding them entirely erroneous, that is to say, the farm area of the agricultural census is not in excess of the total area as reported by the geographer; 30 more are disposed of by his statement that the differences are so slight as to be within the possible error of his own figures; 7 of the remaining 16 are disposed of by the uniform practice of the census office in assigning all of a farm extending into two counties to the county where the manager resides. In only 9 of the 102 counties in which apparent discrepancies were pointed out were those discrepancies caused wholly by error either on the part of the enumerator or the clerical force in the census office, and the effect of these errors, together with all lesser discoveries, upon the returns of the whole county is infinitely small.

2. The intentional changes of the enumerators' returns made in the office

in the process of correcting obvious errors modified the original returns for states and the country by only a small fraction of 1 per cent.

3. The retabulation of the returns, as revised, shows a variation from the printed figures of less than one-third of 1 per cent.

4. No practicable method other than the one adopted could have secured the result so speedily or with a smaller margin of error.

5. There is no evidence of systematic and important duplications or exaggerations in farm acreage or farm products.

6. The differences between the results of the twelfth census and other sources of information are due to the fact that the latter have understated the agricultural area and products of the nation to a degree hitherto unrecognized.

7. Omissions of farm acreage have been more frequent than duplications, and therefore all the important agricultural figures are below rather than above the truth.

8. This error of omission is greatest for the minor crops and for the unimproved farm lands.

9. For the acreage of improved farm lands and for the great staple crops for the country and the leading agricultural states the figures may be deemed within 1 per cent. of the truth.

10. Complete confirmation of the figures for cotton grown and wheat grown is found in the agreement with the figures of the division of manufactures for cotton ginned and wheat ground, supplemented by the export figures for wheat and proper allowance for seed wheat.

11. The retabulation of the 102 counties in the state of Iowa have revealed a degree of accuracy in the agricultural statistics so far as relates to area, which, in view of conflicting official statistics of acreage, is highly gratifying, and should confirm public confidence in all the work of the twelfth census.

The accuracy and completeness of the twelfth census statistics of agriculture are greater than at any previous census.

### III.

We have now traced the actual facts which concern the discrepancy between the agricultural returns of the Census Bureau and the Department of Agriculture. We have set forth the charges made against the accuracy of the census itself. We have traced the history of the investigation by which it was sought to prove the truth or falsity of those charges. We have found its results inconclusive, defective, and characterized by a want of scientific accuracy and a disregard of some of the plain facts in the case which necessarily leads us to reject them. If the

outcome of the investigation made by the crop statistics committee must be disregarded, the inquiry is thrown back to the point it had reached prior to the appointment of the committee itself. The Census Bureau had made a farm-to-farm canvass. Its figures were based upon nothing save the direct question of the enumerator and the answer of the farmer. It had gone directly to the sources of information — namely, the producers themselves; it had obtained more, and more detailed, information than any preceding census; and it had tabulated and condensed this information by an unusually elaborate process in which machinery (with its presumed possibilities of greater exactness) had been used to an unprecedented extent. Certainly there could be no good reason for refusing to accept the returns of the Census Bureau, save upon the ground that there had been some flaws in the mode of conducting this process of collecting returns from farmers, or of classifying them in the office. Owing to the organization of the Census Bureau upon a permanent basis, it would be impossible to ignore or neglect the returns, as might have been done at former decennial periods. There was every probability that a quinquennial census of agriculture would be ordered. There was and is an imminent possibility that that census might even be made annual. It was certain that the differences between the census returns and those of the Division of Statistics would continue to increase at a compound rate with every succeeding crop year. The attention of producers, of traders, and of speculators on the exchanges, had been concentrated upon the two sets of figures during the early part of 1902.

This would leave us still with the *a priori* opinions in favor of the census which, as we have already so often remarked, are drawn from the fact that the census results are obtained by actual enumeration, while the reports of the department are but estimates or guesses. It may very well be answered that an *a priori* assumption in favor of a set of figures is not enough. The business world cannot afford to guide itself by returns whose accuracy has been seriously called in question. It is true that the census figures correspond closely to the commercial estimates



for certain crops. Yet it is also clear that there are many who cannot rest satisfied with figures upon which so dark a shadow has been cast by the aspersions of those who profess greater faith in the work of the Department of Agriculture. Is there no way in which the two sets of statistics can be subjected to the test of probability and of general knowledge? In seeking for such a method of testing the statistics, an inquirer is naturally led to turn from the study of absolute totals, and to direct his attention to comparisons between these figures and those which were presented at former census periods by the census itself and by the Department of Agriculture.

The following table has been specially computed<sup>1</sup> for the purpose of instituting such a comparison. It presents the gross acreage devoted throughout the country to the eight principal crops—barley, buckwheat, corn, oats, rye, wheat, hay, and cotton—as reported by the Census Bureau and by the statistician of the Department of Agriculture for the census years 1889 and 1899, and in 1888. To this has been added a review of the numbers of persons engaged in agriculture in 1900, 1890, and 1880.

The department has made for many years more or less regular estimates of the acreage and production of barley, buckwheat, corn, oats, rye, wheat, hay, cotton, and potatoes. The acreage of the latter was not ascertained by the census for more than a few states in 1880, and hence no comparison can be made back of 1890 for crops other than the eight first named. These eight crops in 1900 had an acreage, as reported by the census, of 270,606,176; this constituted 93.5 per cent. of the acreage of all crops. The other crops, though very numerous, were cultivated in small areas and made up but 6.5 per cent. of the aggregate. The changes in the acreage of these eight crops correspond quite closely with the changes in the acreage of all crops and express the movement of American agriculture. To be accepted as fairly accurate or reasonable, the census

<sup>1</sup> The author is indebted for this table to Hon. L. G. Powers, chief statistician for agriculture, United States census office, who has had the table prepared in the census office in response to a request for a comparative exhibit of farm acreage as reported by the census and by the Statistician of the Department of Agriculture.

A COMPARATIVE EXHIBIT FOR SPECIFIED YEARS, OF THE ACRES OF BARLEY, BUCKWHEAT, CORN, OATS  
 RYE, WHEAT, HAY, AND COTTON, AS REPORTED BY THE CENSUS AND BY THE STATISTICIAN OF THE  
 DEPARTMENT OF AGRICULTURE AND OF THE PERSONS ENGAGED IN AGRICULTURE, BY STATES AND  
 TERRITORIES.

	ACRES OF EIGHT PRINCIPAL CROPS.								
	Census.			Statistician of Agriculture.			Persons Engaged in Agriculture.		
	1899.	1889.	1879.	1899.	1889. <sup>1</sup>	1888.	1900. <sup>2</sup>	1890.	1880.
The United States.....	270,606,176	213,341,612	163,742,852	222,982,127	223,259,495	203,859,091 <sup>3</sup>	10,381,796	8,565,926	7,670,493
North Atlantic division	21,876,493	22,074,672	21,940,204	19,471,348	22,891,535	22,541,007	1,074,412	1,099,465	1,039,601
Maine.....	1,437,150	1,479,079	1,466,312	1,169,018	1,499,659	1,522,601	76,923	81,284	82,130
New Hampshire.....	657,377	714,220	762,999	665,920	738,454	772,070	38,782	42,279	44,490
Vermont.....	1,166,502	1,179,111	1,225,685	1,031,235	1,210,950	1,264,715	49,820	53,939	55,251
Massachusetts.....	663,408	690,761	744,129	658,025	724,267	754,210	66,551	69,720	64,973
Rhode Island.....	80,328	106,772	122,469	85,107	114,269	125,866	10,957	11,630	10,945
Connecticut.....	550,587	597,423	678,780	558,738	630,431	702,205	44,796	45,596	44,026
New York.....	8,280,042	8,482,476	8,314,286	7,340,207	8,840,001	8,590,034	375,990	397,541	377,460
New Jersey.....	1,033,463	1,059,624	1,186,132	942,711	1,191,081	1,262,171	68,881	68,603	59,214
Pennsylvania.....	8,007,636	7,772,206	7,439,412	7,020,387	7,942,423	7,547,135	341,712	328,873	301,112
South Atlantic division	25,840,983	23,387,758	21,742,538	24,852,823	26,301,796	24,586,317	2,032,569	1,669,014	1,618,391
Delaware.....	393,572	365,849	350,694	342,579	418,168	394,653	19,002	18,187	17,849
Maryland.....	1,743,113	1,612,054	1,637,787	1,728,307	1,812,404	1,785,875	95,554	91,301	90,927
District of Columbia	1,771	2,116	4,245	.....	1,674	.....	1,488	1,752	1,464
Virginia.....	3,804,993	3,537,062	3,680,144	3,476,447	4,345,290	3,962,440	300,268	259,327	254,099
West Virginia.....	1,909,363	1,739,707	1,500,149	1,774,835	1,741,384	1,585,634	151,722	119,874	107,578
North Carolina.....	5,008,803	4,965,475	4,515,482	4,770,454	5,555,565	5,324,217	459,306	370,811	360,937
South Carolina.....	4,353,598	3,791,039	3,111,151	4,617,489	4,205,315	3,852,518	393,693	326,528	294,602
Georgia.....	7,780,039	6,726,603	6,288,002	7,436,424	7,445,441	6,956,377	522,848	416,268	432,204
Florida.....	845,731	656,853	654,884	700,288	776,555	776,403	88,688	64,866	58,731
North central division	155,046,689	122,862,474	85,677,725	122,836,519	122,712,701	107,816,701	3,508,808	3,117,043	2,716,810
Ohio.....	11,230,221	9,777,306	9,047,338	8,194,675	9,802,810	9,244,956	414,662	400,229	397,945
Indiana.....	10,914,123	9,077,908	8,246,655	9,002,177	9,861,521	8,970,722	322,229	322,229	331,240
Illinois.....	20,112,926	17,714,294	16,928,976	15,410,513	18,014,332	17,668,507	402,781	431,532	436,371
Michigan.....	7,049,624	5,016,422	4,635,302	5,399,387	5,846,971	4,919,034	312,462	287,025	240,319
Wisconsin.....	7,774,926	6,551,319	5,812,214	5,646,611	6,860,348	6,231,929	270,007	237,059	195,901
Minnesota.....	14,364,459	9,006,235	5,287,565	9,596,205	8,574,721	7,303,261	258,944	192,291	131,535
Iowa.....	21,569,473	17,799,808	13,980,822	17,399,808	19,081,264	16,770,876	371,604	322,057	303,557
Missouri.....	13,950,847	12,052,023	10,019,661	10,542,366	12,767,151	11,026,241	463,293	390,201	355,297
North Dakota.....	7,020,908	3,794,065	642,030	5,313,883	8,828,438	.....	71,626	43,886	.....
South Dakota.....	8,499,098	5,250,517	.....	7,321,169	.....	7,131,909	82,857	68,505	28,508
Nebraska.....	14,895,355	10,424,214	4,019,015	13,886,211	9,228,279	8,056,308	186,587	170,170	90,507
Kansas.....	17,664,435	14,298,363	7,058,147	17,483,514	13,846,866	10,412,958	271,252	250,659	206,080
South central division	52,576,053	35,420,170	29,219,464	43,826,283	40,644,868	39,732,416	3,300,817	2,321,694	2,116,570
Kentucky.....	5,771,064	5,220,432	4,998,148	4,326,353	5,054,628	5,094,922	408,185	320,191	320,571
Tennessee.....	6,324,082	5,607,106	5,524,215	5,325,960	6,947,024	6,723,362	413,406	330,835	294,153
Alabama.....	6,373,613	5,315,631	4,994,842	6,043,920	6,093,527	6,226,518	515,737	372,046	380,630
Mississippi.....	5,367,151	4,792,211	3,928,955	5,419,242	5,375,806	5,022,155	490,582	359,658	339,938
Louisiana.....	2,845,464	2,162,424	1,671,592	2,674,006	2,422,780	2,218,761	295,445	239,091	205,306
Texas.....	14,822,471	8,281,492	5,325,536	12,965,163	10,146,986	10,329,679	644,634	430,616	359,317
Oklahoma.....	3,776,364	51,725	.....	1,960,141	31,969	.....	94,931	13,911	.....
Indian Territory.....	2,433,904	70,078	35,000	299,161	70,078	.....	92,418	.....	.....
Arkansas.....	4,861,940	3,919,071	2,741,171	4,812,337	4,502,070	4,116,719	345,479	255,346	216,655
Western division.....	15,265,958	9,596,538	5,162,921	11,995,154	10,708,595	7,176,037	465,159	358,710	179,121
Montana.....	1,129,943	377,195	100,726	500,438	475,650	367,988	28,693	15,107	4,513
Wyoming.....	431,297	194,825	25,397	310,185	173,657	120,263	13,407	8,092	1,639
Colorado.....	1,477,513	832,707	213,238	1,362,337	726,523	490,639	44,904	38,269	13,539
New Mexico.....	183,760	87,715	110,832	257,798	186,761	187,621	27,214	23,604	14,139
Arizona.....	146,652	50,669	28,836	49,986	64,571	81,911	16,174	6,942	3,435
Utah.....	643,752	282,246	181,709	418,031	363,923	383,026	29,414	20,298	14,550
Nevada.....	323,235	155,729	104,420	195,647	166,640	224,937	5,890	5,663	4,180
Idaho.....	883,444	288,676	78,876	402,049	318,765	267,241	27,489	13,596	3,858
Washington.....	1,848,036	786,684	193,686	1,390,272	854,275	842,961	61,113	43,494	12,781
Oregon.....	1,954,471	1,295,767	799,377	1,998,889	1,576,103	1,628,462	58,490	47,129	27,091
California.....	6,243,855	5,244,325	3,319,824	5,109,522	5,801,727	4,580,988	152,371	136,516	79,396

<sup>1</sup> Acreage of wheat, oats, and corn from report of the statistician of agriculture; acreage of rye, barley, buckwheat, hay, and cotton from census report of 1890.

<sup>2</sup> Including thirty-one persons in military and naval service (including civilian employees, etc.) stationed abroad, not credited to any state or territory.

<sup>3</sup> 6,613, representing all other states and territories, including Missouri for cotton, contained in total.

reports or the department's estimates must correspond with all correlated facts concerning the movements of that agriculture.<sup>1</sup>

From 1880 to 1890 the population of the United States increased 24.9 per cent., and from 1890 to 1900, exclusive of Alaska and Hawaii, 20.7 per cent. During the same periods the acreage of these eight selected crops increased from 163,742,852 in 1879 to 213,341,612 in 1889 and 270,606,176 in 1899. The percentage of increase for the first period was 30.3 and for the second 26.8. In each case the relative gain in crop acreage was somewhat greater than that of population. The difference was due to the exports of the products of the farm. The value of those exports in 1880 was \$685,961,091; in 1890, \$629,820,808; and in 1900, \$835,858,123. There was a decline in the average value of the various articles of export, and hence there was a slight increase in the quantities exported in 1890, as compared with those sent abroad in 1880, and a much greater increase in the quantities exported in 1900, than is indicated by the increased values. The increase in the last decade represents the product of at least 8,000,000, and possibly 10,000,000, acres of cultivated crops, and twice as many acres of pasture land utilized for grazing domestic animals. The increase in the acres of the eight selected crops between 1890 and 1900 is therefore no more than sufficient to account for this and to provide supplies for home consumption to keep pace with the 20.7 per cent. gain in population. The figures of population and exports, while corresponding fairly well with those for crop acreage, furnish more ground for asserting that the census of agriculture has failed to secure a complete enumeration rather

<sup>1</sup> The statistical division of the Department of Agriculture was organized by Mr. J. R. Dodge, who continued in charge for many years. In stating the limitations under which estimates were made and the margin of possible error that accompanied the same, Mr. Dodge often asserted that the aggregate of acreage in a census year for all crops estimated ought to coincide very closely with the corresponding total as reported by the census. There might reasonably be expected considerable variation in the acreage of individual crops, but the totals should harmonize for the nation and for groups of states within very small limits.

Since the publication of its figures for crop acreage and production by the twelfth census, many persons have called attention to the wide variation between the census figures and the corresponding estimates of the department for individual crops. No one has, however, presented a comparison between the aggregates for all crops.

than reported an excess of these eight selected and leading crops.

The same conclusion is reached when consideration is given to the number of persons engaged in agriculture at the different census years. The numbers reported in 1880, 1890, and 1900 were 7,670,493, 8,565,926, and 10,381,796. From 1880 to 1890 there was an increase of 9.9 per cent., and from 1890 to 1900 an increase of 21.2. A part of the increase in the latter decade is due to the inclusion of more children under sixteen than in former years. After making a most liberal allowance for this variation, it is found that the people engaged in agriculture increased in the last decade not less than 12.5 per cent., as compared with an increase in 1880 to 1890 of only 9.9 per cent. The relative increase in the number of those engaged in agriculture was greater in the last decade than in the preceding one, while the census reports of crop acreage show a greater per cent. of increase in the preceding ten-year period.

The estimates of the Department of Agriculture for the decade 1892 to 1901 are based upon the data of the census of 1890. To be accurate they must reflect the growth of American agriculture in the intervening years. The estimates for these eight crops thus start with the ascertained acreage in 1889 of 213,341,612. Those estimates give for 1899, after ten years of agricultural progress in the country, an acreage of 222,982,127. This is only 9,640,515, or 4.5 per cent., over the area of 1889. This acreage which the estimates add to the census totals of 1890 barely suffices to provide for the increase in agricultural exports. It gives to a population of 75,000,000 no more for home consumption than the census reports of 1890 allowed for a population of 62,590,000. This could be possible only provided either the estimates of the department were too low for 1899, or the census of 1890 reported a crop acreage grossly in excess of the fact.

The analysis of the census figures of crop acreage for individual states in all cases confirm their accuracy, and a like analysis for the department's estimates furnishes evidence of their inadequacy. In the nine north Atlantic states there have

been but few changes in agriculture or agricultural conditions in the past twenty years. This general stability is reflected in the acres for these eight selected crops and for all cultivated crops as reported by the census. The acreages for the eight crops thus reported for 1880, 1890, and 1900 were 21,940,204, 22,074,672, and 21,876,403. The estimates of the Department of Agriculture indicate not a fixity, but a tremendous falling off, the totals for these eight crops estimated in 1899 being 19,471,348 acres, or 11.8 per cent. less than the census gave for 1899. The numbers of people engaged in agriculture, as reported by the census for 1880, 1890, and 1900, were 1,039,601, 1,099,465, and 1,074,412. This would give to each worker an average of 21.1 acres in 1880, 20.1 in 1890, and 20.4 in 1900. The tables of occupation thus tend to support the census figures of crop acreage and prove that the estimates of the department are too low for 1899.

No available information relating to agricultural conditions indicates a decadence in agriculture or a decrease in agricultural operations in any of the states of Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Missouri, Delaware, Virginia, North Carolina, Kentucky, Tennessee, and California. In northern Michigan and Wisconsin great numbers of new farms have been opened up in ten years. In Ohio, Indiana, Illinois, Iowa, and Missouri the purchase of range cattle and stock for feeding purposes has increased in many sections, and hence there has been an increase in all crops utilized for food for domestic animals. The same conditions prevail with modifications in most of the other states included in the list last mentioned. The census figures for acreage of these eight crops were for the last three decennial years as follows: 91,059,475, 105,023,329 and 120,148,503. The increase from 1880 to 1890 was 15.3 per cent., and from 1890 to 1900, 14.4 per cent. The acreage thus reported harmonizes therefore with the census tables for occupation, which give to these thirteen states an aggregate for the three years of 3,587,185, 3,827,399, and 4,390,080.

But while all available information indicates the correctness of the census figures, which show an increase of 14.4 per cent.

in the acreage of these staple crops in the ten years ending with 1899, there is nothing which confirms the correctness of the department's estimates which aggregate for the thirteen states only 92,592,852, or 11.8 per cent. less than the census returns of 1899, and only 1,533,387 acres, or 1.6 per cent., more than the census figures of 1879. The facts all lead to the conclusion that the crop acreage as estimated for these states by the department is 22.9 per cent. short. Combining the north Atlantic states and the thirteen last mentioned, we have a total of twenty-two which raise 52.5 per cent. of all the crops of the nation. They include an area greater than all Europe with the exception of a portion of Russia. The census reported for these twenty-two states for 1880 an acreage in these leading crops of 112,996,679; in 1890, 127,098,001; and in 1900, 142,024,996. From 1880 to 1890 the percentage of increase was 12.5, and from 1890 to 1900, 11.7. But where the census, reflecting well-known facts, shows an increase in crop acreage of 11.7 per cent., the estimates of the department indicate a decrease of 11.8 per cent., giving to 1899 a total crop acreage for the twenty-two states of only 112,064,200, or nearly a million acres less than the census reported twenty years before, and 21.1 per cent. less than the census report of 1899.

The decline in crop acreage shown by the department's estimates for 1899 in these twenty-two states was one which would have wiped out the progress of the decade from 1879 to 1889. It was a decline nearly as great relatively as that reported in the southern states in the decade from 1860 to 1870. The year 1899 was one of the most prosperous agriculturally that this country ever beheld, but the department estimated for that year a crop acreage which indicated a decline since 1889 sufficiently great to mark the effects of a calamity or retrogression as great as that which accompanied the ravages of four years of civil war in the South. To state this fact is but to mark the absolute inadequacy of the estimate. That estimate harmonizes with no known facts, while the census returns merely give an acreage that agrees with this increase of national population, the increase in agricultural exports, and in the number of people engaged in farming, etc.

In the twenty-eight states and territories other than those above mentioned by name the department's estimates show an increase of acreage from 1889 to 1899. But such increase is less than that indicated by the census reports. For the wide area included in these states it is safe to conclude that the estimates themselves are as deficient as those passed in review for the twenty-two states previously mentioned. This is evidenced by the totals for the nation, to which attention has already been called. The error of the whole is seen in the fact that those estimates reflect none of the increase that is known to have taken place in the nation and in the greater portion thereof, but instead make agriculture less advanced for a wide territory than it was twenty years before.

The failure of the department's estimates to keep track of the growth of American agriculture may be seen by another comparison. The forty-six states and territories, outside of Texas, Oklahoma, Indian Territory, and Kansas, in 1879 reported an acreage in these eight staple crops of 151,324,169; in 1889, of 190,639,934; and in 1899, of 231,909,002. The increase for the decade 1879-89 was one of 26.0 per cent.; and for the succeeding decade of 21.6 per cent. The increase shown by the census, when taken into account with all the known facts concerning this vast territory, is not as great as might reasonably have been expected. But, while this is the case, the department's estimate for this same territory marks an actual decline since 1889, for the estimates include an acreage for 1899 of only 190,274,148, as compared with census figures for 1889, showing 190,639,934 acres. If this last is accepted, there must have been actually a decline in agriculture in all these forty-six states and territories, instead of a gain, as has been popularly supposed.

If the analysis herewith presented is correct it must follow that the Agricultural Department is guilty of statistical error in its Crop Report Service. That there are large discrepancies between the figures of the census and those of the department, no one can deny. That the alleged investigation made by the committee representing the National Board of Trade was unsatisfactory and inconclusive can not be disputed. It has failed to

convict the census of serious error, and in so doing it has left the figures of the Agricultural Department still open to the doubt cast upon them prior to the investigation. By further analysis we have seen that, irrespective of the reports of the census, it would seem as if the figures for acreage furnished by the department were impossible, not to say absurd. Yet we have already noticed the great and growing need for correct crop reports felt by the business world. How can these be secured? Can the Agricultural Department be induced to make such changes in method as will result in reliable service, or is this impossible? The answer to this question is not easy to make. It must depend very largely upon a variety of considerations connected partly with political conditions, but depending partly upon the nature of the service expected of the department and the difficulties necessarily to be encountered by it. In another paper it will be sought to sketch the political and other influences affecting the general statistical situation in Washington.

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